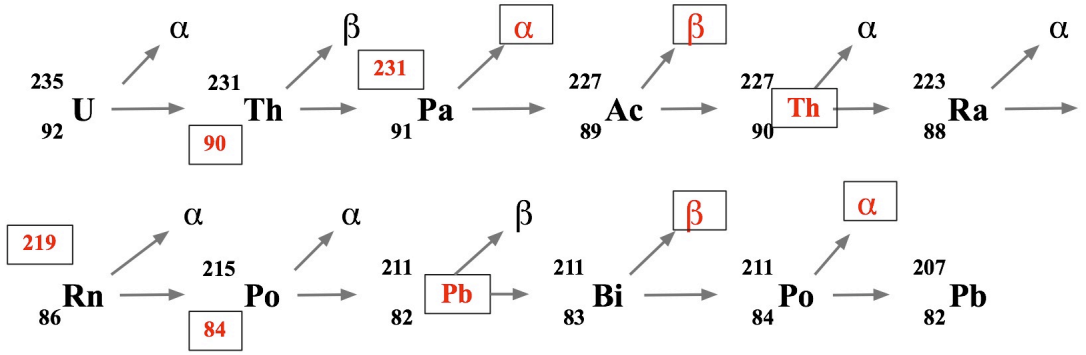
WKS

Decay Series & Induced Transmutation

Name Answer Key

Period _____ Date _____

1. Complete the following radioactive decay series:



2. What kind of nucleus does every radioactive decay series end with?
   A stable nucleus.

Induced Transmutation

3. Describe the process of induced transmutation. What is the large machine used to achieve these reactions called and how does it work?
   A target nucleus is struck with high-velocity charged particles. The new nucleus has a greater number of protons. The machine that performs this is a particle accelerator, a device that uses electromagnetic fields to propel charged particles to high speeds and to contain them in well-defined beams, then collide them.

Fill in the blanks to complete the following equations. Use a periodic table to identify elements by atomic number.

4. $^{206}_{82}\text{Pb} + {}^{4}_{2}\text{He} \rightarrow \underline{\ {}^{210}_{84}\text{Po}\ }$ A=206+4=210 Z=82+2=84

5. $^{238}_{92}\text{U} + {}^{4}_{2}\text{He} \rightarrow \underline{\ {}^{241}_{94}\text{Pu}\ } + {}^{1}_{0}\text{n}$ A=(238+4)−1=241 Z=(92+2)−0=94

6. $^{238}_{92}\text{U} + {}^{1}_{0}\text{n} \rightarrow {}^{0}_{-1}\text{e} + \underline{\ {}^{239}_{93}\text{Np}\ }$ A=(238+1)−0=239 Z=(92+0)−(−1)=93

7. Complete the equation for the proton ($^{1}_{1}\text{p}$) bombardment of Be-9:

$$^{9}_{4}\text{Be} + {}^{1}_{1}\text{p} \rightarrow {}^{4}_{2}\text{He} + \underline{\ {}^{6}_{3}\text{Li}\ }$$ A=(9+1)−4=6 Z=(4+1)−2=3

8. Write the balanced nuclear equation for the induced transmutation of aluminum-27 into a new nucleus by neutron bombardment. An alpha particle is released in the reaction along with another nucleus, which you must determine.

$$^{27}_{13}\text{Al} + {}^{1}_{0}\text{n} \longrightarrow {}^{4}_{2}\text{He} + {}^{24}_{11}\text{Na}$$ A=(27+1)−4=24 Z=(13+0)−2=11

9. Rutherford discovered the proton by observing that H-1, which he realized was a proton, was a product in the alpha-particle bombardment of many gases. Write the complete equation for the alpha-bombardment of N-14, producing H-1 (a proton) and one other nucleus (which you must determine).

$$^{14}_{7}\mathrm{N} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{1}_{1}\mathrm{H} + {}^{17}_{8}\mathrm{O} \quad \begin{matrix} A=(14+4)-1=18 \\ Z=(7+2)-1=8 \end{matrix}$$

or

$$^{14}_{7}\mathrm{N} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{1}_{1}\mathrm{p} + {}^{17}_{8}\mathrm{O} \quad \begin{matrix} A=(14+4)-1=18 \\ Z=(7+2)-1=8 \end{matrix}$$

10. Write the equation for the bombardment of Am-241 with Be-9 that creates 3 neutrons and another nucleus, which you need to find:

$$^{241}_{95}\mathrm{Am} + {}^{9}_{4}\mathrm{Be} \rightarrow 3\left({}^{1}_{0}\mathrm{n}\right) + \underline{{}^{247}_{99}\mathrm{Es}};\ \begin{matrix} A=(241+9)-(3\times1)=247 \\ Z=(95+4)-(3\times0)=99 \end{matrix}$$

11. Write the complete equation for the bombardment of Cf-249 with N-15 that produces another transuranium element and 4 neutrons:

$$^{249}_{98}\mathrm{Cf} + {}^{15}_{7}\mathrm{N} \rightarrow 4\left({}^{1}_{0}\mathrm{n}\right) + {}^{260}_{105}\mathrm{Db};\ \begin{matrix} A=(249+15)-(4\times1)=260 \\ Z=(98+7)-(4\times0)=105 \end{matrix}$$

12. Write the balanced nuclear equation for the alpha particle bombardment of $^{239}_{94}\mathrm{Pu}$. One of the reaction products is a neutron [you will need to determine the other].

$$^{239}_{94}\mathrm{Pu} + {}^{4}_{2}\mathrm{He} \longrightarrow {}^{1}_{0}\mathrm{n} + {}^{242}_{96}\mathrm{Cm};\ \begin{matrix} A=239+4-1=242 \\ Z=94+2-0=96 \end{matrix}$$

For more practice, go to http://www.chemteam.info/ChemTeamIndex.html and click on Radioactivity.